NASA Earth Science Enterprise
Technology Planning Workshop

Overview of Key Technology Areas

George Komar

ESTO

Goddard Space Flight Center

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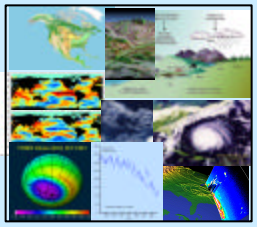
Hyatt Arlington Hotel - Arlington, VA

ESE Technology Development Process

Earth Science Research Plan



Baseline Measurement Studies

Earth Science Vision

Outside Technology Pipeline

- **Cross Enterprise Technology**
- **Other Agencies**
- **Industry**

Emerging Technology

ESTO
Earth ScienceTechnology Office

- **Instrument Incubator**
- **Advanced Technology Initiatives**
- **Advanced Information Systems Technology**

Flight Validation Rationale

NMP
New Millennium Program

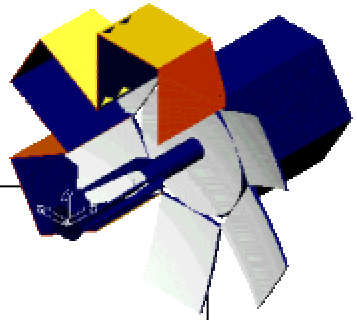
Future ESE Mission

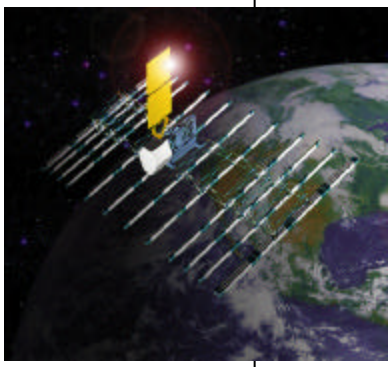
Approach to implementing the process

- NMP and ESTO have initiated planning for spacecraft and instrument technologies to enable Earth Science Enterprise (ESE) missions with a time horizon of 5 to 15 years
- Derived from existing ESE science planning documents (ESE Strategic Plan, Earth Science Implementation Plan, Easton Report)
- ESTO has identified critical technologies of overall importance to ESE
  - Large deployable structures
  - Radiometers
  - Radar
  - Laser/LIDAR
  - On-board computing
- NMP has identified key component technologies that could potentially require a validation in space to reduce their cost and risk to the first science user
  - Large, Light-Weight Deployable Antennas
  - Light-Weight Deployable UV/Visible/IR Telescopes
  - Ultra-High Data Rate Communications
  - Intelligent Distributed Spacecraft Infrastructure
  - High Performance Spectrometry
- These candidate technologies were presented to the ESE Associate Administrator for his review and concurrence

ESTO planning/ ranking process

- Use ‘needs’ from BMS (Easton)
- Use desired measurement dates from SIP V.2
- Focus on target launch dates of ‘05-’07 (3 years) for immediate technology investments





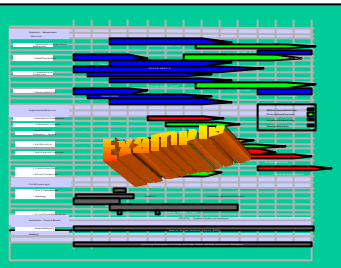
Platform	Comment
Material & Structures	Large deployable apertures needed
Comm	High bandwidth downlink desirable
GN&C	Elements being developed elsewhere
C&DH	No strong needs
Power	No strong needs
Instrument	
Detectors & Filters	Nothing pressing
Radar	Strong needs
Spectrometers	No strong needs
Optics	No strong needs
GPS	No strong needs
Lidar/ Laser	Strong needs
Radiometer	Strong needs
Info Systems	
Intelligent Platform control	No strong needs
On-board processing/ inst. cont.	Strong needs
On-board data storage/ processing	No strong needs
Transmission	No strong needs

Proposed priority technology areas

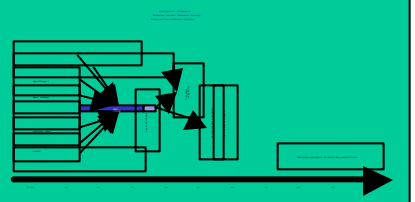
Platform	Instrument	Info systems
M&S (large deployables)	Radar	On-board processing/ sensor control
	Radiometers	
	LIDAR / Laser	

Typical Workshop Process

Input



Science Timeline



Preliminary roadmap

Workshop

- Small team
- One day
- Science and technology backgrounds
- "in the business"

Output

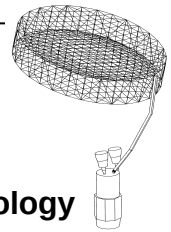
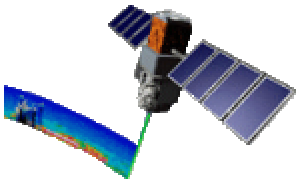
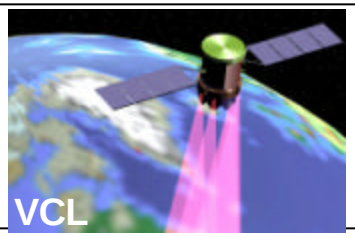
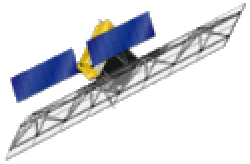
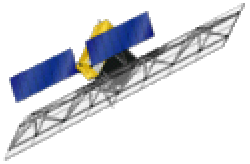
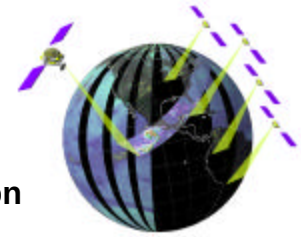
- List of Technology tasks
- Rough scoping of tasks
- Suggested timing

Improve

Workshop Status

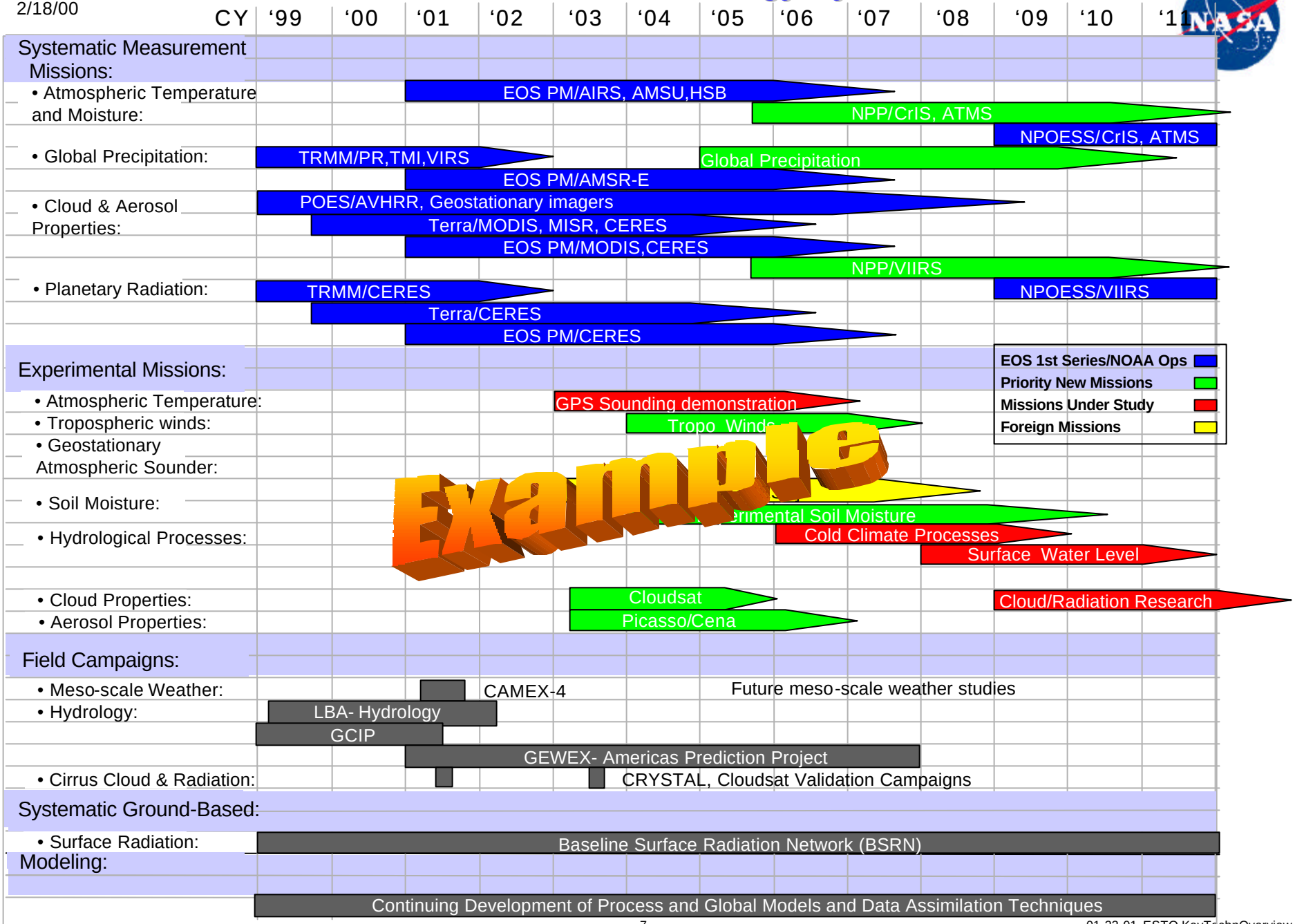
Topic	Date
Lidar/ Laser	4/20/00
Radar	4/20/00
Materials and Structures (Large deployables)	5/3/00
Information Technology	8/29/00
Radiometers	11/1/00

Summary of Workshop Key Findings

Workshop Title	Key Conclusions	Next Steps
Materials and Structures (Large deployables)  Hydrology	• Many benefiting missions • Many types of deployables • Wide ranging requirements • Issues include materials, actuation	• Formulate development sequence • Support mission concept • Establish performance metrics • Hand off (as appropriate) to NMP
Lidar / Laser   	• Many benefiting missions • Many types of laser systems with several common elements • Wide ranging requirements • Issues include diode lifetime, efficiency, autonomous ops.	• Define rules for stretching deliveries • Replan roadmap with lower funding requirements
Radar   L-band Tandem SAR	• Many benefiting missions • Antenna technology key • Improved rf also critical	• Define rules for stretching deliveries • Replan roadmap with lower funding requirements
Radiometers  Cloud Ice Radiometer	Many benefiting missions Several investment areas: • Polarimetry • mm and submm radiometry comp. • mw receivers • STAR • Spectrometers	• Develop investment priorities • Solicit proposals
Information Technology (on-board processing/ sensor control  Global Precipitation	• Crucial to near term missions with reconfigurable observations • Fundamental to the Visions Sensorweb concept	• Develop investment priorities • Solicit proposals

Global Water and Energy Cycle

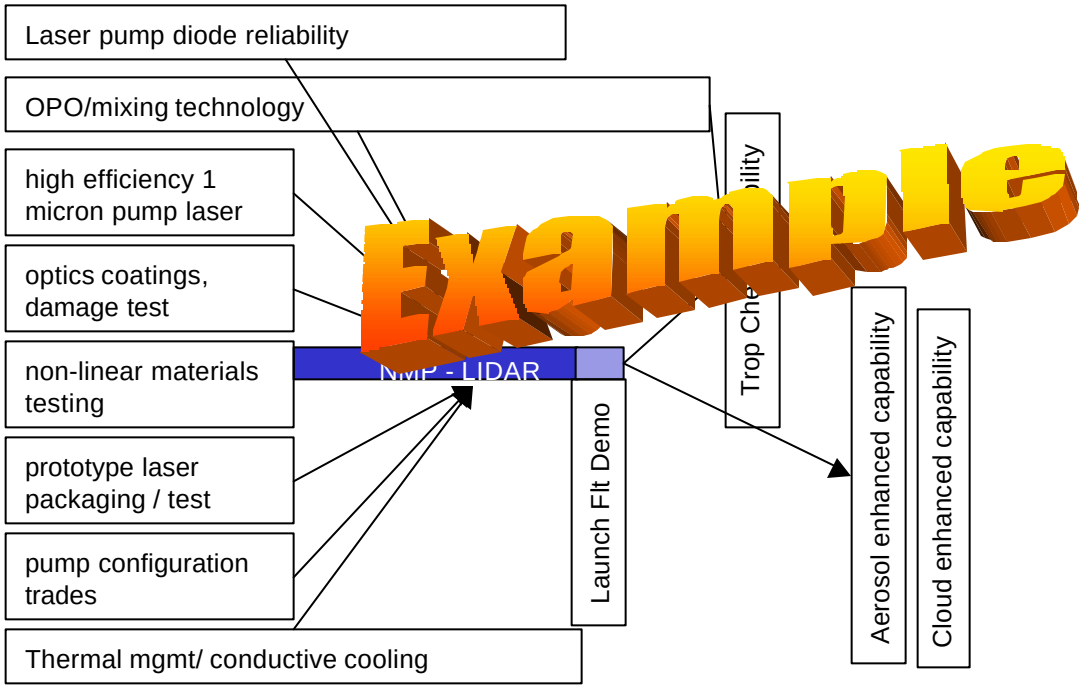
2/18/00



Sample of Roadmaps in breakout packages

Lidar Roadmap

Tropospheric Chemistry/ Enhanced Aerosol Radiative Forcing/ Enhanced Cloud-Radiation Feedback



Need date assumed to be launch date minus 2-3 yrs

Sample of Workshop output
(Radiometry)

WBS			Explanation / comment	Scope		
Functional product	*Task*	*Subtask*		*Level of effort*	*No. yrs needed*	*Delivery date*
MM and Submm Radiometers	Develop improved ambient-temperature Schottky-diode submillimeter-wavelength radiometers	Improve sensitivity ~2x or more over that achieved or EOS MLS, with priority on 640 GHz band.	Needed for EOS-7 MLS (baseline, enhanced, minimum); 640 GHz is key band for stratospheric chemistry	2	2	2004
MM and Submm Radiometers	Develop, improve and flight-qualify millimeter-wavelength MMIC components and modules	Assure performance, and flight-qualify, MMIC receiver modules now being developed at 100-140 GHz and 170-210 GHz under IIF program. Collaborate with an industry partner and perform environmental tes of prototypes.	Needed for stratospheric chemistry and climate, geosynch atmospheric sounders, cloud water vapor, severe storms missions. 10 140 GHz is key band for temperature. 170-210 GHz i key band for water vapor and other chemicals. Essential f baseline EOS-7 MLS	3	3	2005
MM and Submm Radiometers	Develop, improve and flight-qualify millimeter-wavelength MMIC components and modules	Extend MMIC receiver modules upward in	Needed for big as and CO baseline MLS	1	3	2005
MM and Submm Radiometers	Develop, improve and flight-qualify millimeter-wavelength MMIC components and modules	d MMIC receivers and integrated digitizers fo bands at 50, 118 and 183 GHz	Needed for synthetic thinned array radiometer system for geosynch atmospheric sounders	3	3	2005
MM and Submm Radiometers	Develop, improve and flight-qualify millimeter-wavelength MMIC components and modules	Develop low power-consumption fixed-frequency submm local oscillator sources and systems, with priority at 640 GHz and 2.5 THz	Needed for EOS-7 MLS and cloud ice missions. 640 GHz is key band for stratospheric chem and cloud ice. 2.5 THz needed for possible OH measurements with enhance EOS-7 MLS	2	3	2005
MM and Submm Radiometers	Develop and improve submillimeter and millimeter-wavelength solid-state local oscillator systems	Develop low-power tunable (~10% or greater tunability desired) mm and submm local oscillator sources. Priority bands are 640 GHz 2.5 THz	Can enable new class of 'smart sensors' that can be programmed to provide (1) more efficient measurement and (2) measurement flexibility. Will make EOS-7 MLS more efficient and flexible.	2	3	2005